Patent

Attorney's Docket No. ADTP0066USA

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	
	)	
Chih-Chung Chuang,	)	Group Art Unit: 1765
Shin-Jien Kuo,	)	
Chao-Yun Cheng,	)	Examiner: GEORGE, PATRICIA ANN
Shu-Feng Wu	)	
	)	Appeal No.
Application No.: 10/708,642	)	
	)	
Filed: March 17, 2004	)	
	)	
For: METHOD FOR FABRICATING LIQUID CRYSTAL DISPLAY PANEL ARRAY	)	

APPEAL BRIEF

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This appeal is from the decision of the Examiner dated 03/09/2007, finally rejecting claims 1-12, which are reproduced as included in a Claim Appendix to this brief.

This appeal brief is an amended brief in reply to the Notification of Non-Complaint Appeal Brief (37 CFR 41.37) dated June 29, 2007 for overcoming the deficiencies including those listed as Items 1, 4, 8 and 9. This appeal brief is a complete new brief with the required corrections as listed in the Notification of Non-Complaint Appeal Brief mentioned above.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 50-3105. This paper is submitted in triplicate.

A. Real Party in Interest

The real party in interest of the present application is the assignee of record, AU Optronics Corp.

B. Related Appeals and Interferences

NONE

C. Status of Claims

Claims 1-5, and 7-12 are rejected in the Final Office Action dated March 09, 2007. Claims 6 is cancelled in an Amendments to the Claims dated May 28, 2007 and claim 16 was cancelled on April 13, 2006. Claims 13-15 and 17-20 are allowed in the aforementioned Final Office Action. Applicants appeal the rejected Claims 1-5, and 7-12 in this appeal brief.

D. Status of Amendments

An Amendment after Notice of Appeal was filed on May 28, 2007. The Applicants believe that the above amendment has not been acted upon yet by the examiner based upon a review of the current status shown in the PAIR system on July 05, 2007.

E. Summary of Claimed Subject Matter

Applicant provides the following concise summary of the claimed subject matter defined in each of the independent claims involved in the appeal according to 37 CFR 41.37(c)(1)(v), including references to the specification by page, paragraph, and line number (because there are no visible line numbers shown for each of the pages of the specification as filed; therefore for the sake of clarity, the line numbers described below are in reference with respect to each of the paragraphs in the specification; furthermore, the page numbers are reference to the page numbers assigned in the published copy of the present application (Pub. No. 12004/0209471 A1 dated Oct. 21, 2004)), and to the drawing, if any, by reference characters.

Independent claims 1 and 13 of the present application are mapped to the specification and drawing(s) as follows:

1. A front-end array process for making a liquid crystal display panel (page 1, paragraph [0007], lines 1-3; pages 1-2, paragraph [0017], lines 1-3), comprising:

depositing a molybdenum-containing metal layer on a glass substrate (page 2, paragraph [0017], lines 4-7; page 2, paragraph [0018], lines 3-5), wherein said molybdenum-containing metal layer is a dual-metal layer (page 2, paragraph [0018], lines 3-5);

forming a patterned photoresist on said molybdenum-containing metal layer, wherein said patterned photoresist defines a gate and word line array pattern (page 1, paragraph [0011], lines 5-6; page 2, paragraph [0017], lines 4-5; page 2, paragraph [0018], lines 3-6) ; and

using said patterned photoresist as an etching mask (page 2, paragraph [0018], lines 6-7), uniformly etching said molybdenum-containing metal layer to form said gate and word line array pattern having substantially oblique sidewalls (page 2, paragraph [0018], lines 7-13), wherein said etching of said molybdenum-containing metal layer uses gas mixture (page 2, paragraph [0018], lines 9-11), wherein said

etching of said molybdenum-containing metal layer is detected by an end-point detection method (page 2, paragraph [0018], lines 23-26; page 2, paragraph [0019], lines 9-11).

13. A front-end array process for making a liquid crystal display panel (page 1, paragraph [0007], lines 1-3; pages 1-2, paragraph [0017], lines 1-3), comprising:

depositing a molybdenum-containing metal layer on a glass substrate (page 2, paragraph [0017], lines 4-7; page 2, paragraph [0018], lines 3-5);

forming a patterned photoresist and defining a gate and word line array pattern on said molybdenum-containing metal layer (page 1, paragraph [0011], lines 5-6; page 2, paragraph [0017], lines 4-5; page 2, paragraph [0018], lines 3-6); and

etching said molybdenum-containing metal layer by using fluorine/oxygen containing gas mixture containing SF6/O2 with a ratio of about 700sccm/300sccm (Fig. 1, Example 2: 0_2(sccm), SF_6 (sccm); page 2, paragraph [0020], lines 1-27; page 2, paragraph [0018], lines 9-11; page 2, paragraph [0019], lines 17-21),

and using said patterned photoresist as an etching mask (page 2, paragraph [0018], lines 6-7) to form said gate and word line array pattern (page 2, paragraph [0018], lines 5-6).

The primary object of the present invention is to provide an improved method for fabricating liquid crystal display devices, thereby alleviating or eliminating Mura defects of LCD panels.

Another object of the present invention is to provide a method for forming a Mo/AlNd, MoW/AlNd, or MoW/Al dual-layer metal array of LCD panels by using End-Point Detection (EPD) instead of prior art time-mode etching.

The preferred embodiment of the present invention includes the steps of providing a substrate having a main surface; depositing a dual-metal layer such as Mo/AlNd, MoW/AlNd, or MoW/Al onto the main surface of the substrate; defining gate and word line patterns using layers of photoresists; and using the photoresists as an etching mask, a first metal dry etching process is carried out to etch the dual-metal layer at an etching selectivity that is significantly higher than prior art. The first metal dry etching process uses oxygen/fluorine containing an etching gas mixture and oxygen/chlorine containing an etching gas mixture to form the dual-metal gate and word line patterns having slightly oblique sidewalls. End point detection mode is used in the first metal dry etching process.

The present invention is emphasized on the improvement of uniformly etching of the upper metal of the dual-metal layer. Further, the etching selectivity between the upper metal and the lower metal of the dual-metal layer is increased such that more reliable end-point detection in the first metal dry etching process can be used. In addition, to avoid so-called white pad effects, the ashing rate of the photoresist is reduced due to recipe change.

F. Grounds of Rejection to be Reviewed on Appeal

The issue on appeal is whether claim 1 is unpatentable under 35 U.S.C. §103(a) over Hong et al. (USPN 6429057) in view of Rioux (USPN 5554488) and Kim et. al. (USPN 4981816).

G. Argument

1. Rejection under 35 U.S.C. 103(a) over U.S. Patent No. 6429057 in view of U.S. Patent No. 5554488 and U.S. Patent No. 4981816

Claims 1and 7 currently stands rejected under 35 U.S.C. §103(a) as being unpatentable over Hong et al. (USPN 6429057) in view of Rioux (USPN 5554488) and Kim et al. (4981816).

The Rejection of Claim 1 Under 35 U.S.C. §103(a) as recited above is Improper.

2. The References

i. Hong et al. (USPN 6429057)

Hong et al. discloses a front end array process for making an LCD panel (col. 1.7-11), comprising: depositing a molybdenum-containing metal gate layer which consists of gate line, gate pads, and gate electrodes that can have a single or multiple layered structure and is deposited on a silicon substrate. Hong teaches the use of photolithography masking followed by dry etch to pattern the molybdenum-containing metal layer for forming both gate and data wire, but Hong fails to teach substantially oblique sidewalls.

ii. Rioux (USPN 5554488)

Rioux discloses a method of forming a semiconductor structure. The method provides for a gate structure comprising a multilayer metal stack characterized by smoothly tapered sidewalls (i.e. the resulting gate structure 54, as shown in FIG. 10), with substantially no undercut in which the taper angle may be controlled. The tapered gate structure 54A comes from the second conductive layer 48 **deposited** over the tungsten silicide layer 46 (FIG. 7). The discontinuity 50 over the sidewall propagates into the tungsten layer 48.

iii. Kim et al. (4981816)

Kim et al. teaches a metal for fabricating contact structure through via opening in VLSI circuits employs a dual layer of refractory metal. First a thin titanium layer is deposited, over which a molybdenum layer is formed. An annealing treatment further improves contact resistance characteristics. A preferred etch resolution is achieved using RIE of molybdenum, etched until gas is cut off at the detection of the molybdenum end point.

3. The Examiner's Position

The Examiner's apparent position with respect to the rejections based on 35 U.S.C. §103(a), is that Rioux discloses a conventional method of forming Mo containing metal gate with tapered sidewalls, i.e. oblique sidewalls, formed on the surface of a semiconductor substrate through use of well known photolithography and dry etching method as recited in claim 1. The Examiner recognizes that Hong fails to teach substantially oblique sidewalls. The Examiner has attempted to remedy this deficiency by attempting to combine the tapered sidewalls disclosed in Rioux reference with Hong et al. (USPN 6429057).

4. Arguments pertaining to Claim 1

Independent claim 1 defines a front-end array process for making a liquid crystal display panel. The method includes depositing a molybdenum-containing metal layer on a glass substrate, wherein said molybdenum-containing metal layer is a dual-metal layer; forming a patterned photoresist on said molybdenum-containing metal layer, wherein said patterned photoresist defines a gate and word line array pattern; and using said patterned photoresist as an etching mask, uniformly **etching** said molybdenum-containing metal layer to form said gate and word line array pattern having **substantially oblique sidewalls** ... In other words, the **substantially oblique sidewalls** is the direct result of the uniformly **etching** of the molybdenum-containing metal layer.

The Examiner attempts to combine the method disclosed in Hong et al. (USPN 6429057) in view of the smoothly tapered sidewalls of Rioux (USPN 5554488) and Kim et al. to achieve the claimed invention.

2143.03 All Claim Limitations Must Be Taught or Suggested

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

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i. Improper Combination

The Examiner alleges that Hong et al. discloses a front end array process for making the LCD panel (col. 1.7-11), comprising: depositing a molybdenum-containing metal gate layer which consists of gate line, gate pads, and gate electrodes that can have a single or multiple layered structure and is deposited on a silicon substrate. Hong teaches the use of photolithography masking followed by a dry etch to pattern the molybdenum-containing metal layer for forming both gate and data wire, but fails to teach substantially oblique sidewalls. The Examiner relies on the smoothly tapered sidewalls of Rioux to overcome this deficiency. However, the applicants point out that the profile of the smoothly tapered sidewalls of Rioux is not formed by etching but by deposition.

The smoothly tapered sidewalls of Rioux are first shown in FIG. 7. A second conductive layer 48 comprising tungsten is deposited over the tungsten silicide layer 46 (FIG. 7). Simultaneously, the tapered discontinuity 50 over the sidewall propagates into the tungsten layer 48, **which establishes the tapered profile**. In

other words, the **deposition** of the conductive layer 48 is the **essential reason for the formation of the tapered gate structure 54**.

The Examiner asserts that "Rioux discloses a conventional method of forming Mo containing metal gate with tapered sidewalls, i.e. oblique sidewalls, formed on the surface of a semiconductor substrate through use of well known photolithography and dry etching method." (emphasis added) Applicants disagree with this assertion. Given the above, as a matter of fact the **deposition** of the conductive layer 48 is the **essential reason of the formation of the tapered gate structure 54, NOT by the so-called "well known photolithography and dry etching."**

It appears that the Examiner is attempting to use non-analogous art and incorrect combination reasoning in attempting to achieve the claimed invention.

In the light of the above reasons and lack of disclosure of every feature, the applicants firmly believe that these distinct features distinguish the present invention from the combination of cited prior art references. To sum up, claims 1 is patentable over Hong et al. (US 6,429,057) in view of Rioux (US 5,554,488) and Kim et al.

Furthermore, as claims 2-5 and 7-12 are dependent upon independent claim 1, they should also be in the condition for allowance.

H. CONCLUSION

For at least the reasons set forth above, it is respectfully submitted that the rejection of claims 1-5 and 7-12 are improper and should be reversed.

Respectfully submitted,

Sincerely yours,

Winston Hsu Date: 07/11/2007

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Claims Appendix

Claims 1-5, 7-12 ON APPEAL:

1. (Previously presented) A front-end array process for making a liquid crystal display panel, comprising:

depositing a molybdenum-containing metal layer on a glass substrate, wherein said molybdenum-containing metal layer is a dual-metal layer;

forming a patterned photoresist on said molybdenum-containing metal layer, wherein said patterned photoresist defines a gate and word line array pattern; and

using said patterned photoresist as an etching mask, uniformly etching said molybdenum-containing metal layer to form said gate and word line array pattern having substantially oblique sidewalls, wherein said etching of said molybdenum-containing metal layer uses gas mixture, wherein said etching of said molybdenum-containing metal layer is detected by an end-point detection method.

2. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein after said etching of said molybdenum-containing metal layer, an over etching is carried out.

3. (Previously presented) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said gas mixture is SF6/O2 having a ratio of about 700sccm/300sccm.

4. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said etching of said molybdenum-containing metal layer is executed under a process pressure higher than 25 mTorr.

5. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said etching of said molybdenum-containing metal layer

is further controlled by a source power, a bias power, process pressure, oxygen flowrate and flowrate of fluorine containing gas.

6. (Canceled)

7. (Previously presented) The front-end array process for making a liquid crystal display panel according to claim 6 wherein said dual-metal layer is Mo/AlNd, MoW/AlNd, or MoW/Al, wherein Mo and MoW are top layers, while AlNd and Al are bottom layers.

8. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said etching of said molybdenum-containing metal layer is detected by an end-point detection method at an wavelength of about 704nm.

9. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said gas mixture is oxygen/fluorine containing.

10. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said gas mixture is oxygen/chlorine containing.

11. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said gas mixture is oxygen/chlorine/fluorine containing.

12. (Original) The front-end array process for making a liquid crystal display panel according to claim 1 wherein said gas mixture is SiF6/O2 containing.

Evidence Appendix

NONE

Related Proceedings Appendix

NONE